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3/29/02

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By: 

Date: MAR 4 2002

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant : Andreas Lenniger et al.  
Applic. No. : 09/436,598  
Filed : November 9, 1999  
Title : Power Semiconductor Module With Ceramic Substrate  
Examiner : David E. Graybill  
Group Art Unit : 2814

P R E L I M I N A R Y A M E N D M E N T

Hon. Commissioner of Patents and Trademarks,  
Washington, D. C. 20231

S i r :

Responsive to the final Office action dated December 4, 2001,  
kindly amend the above-identified application as follows:

In the Claims:

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Claim 1 (amended). A power semiconductor module, comprising:

semiconductor components;

a plastic housing having an interior and connecting element openings formed therein;

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a substrate disposed in said plastic housing defining a housing base of said plastic housing, said substrate containing a ceramic plate having a top side and a bottom side with a top metallization layer disposed on said top side and a bottom metallization layer disposed on said bottom side, said top metallization layer facing said interior of said plastic housing being patterned in order to form interconnects and equipped for and receiving said semiconductor components;

terminal elements for providing external terminals, said terminal elements press-fitted into said connecting element openings in said plastic housing; and

wires bonded to said terminal elements and to said semiconductor components.

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Remarks:

Reconsideration of the application is requested.

Claims 1 to 7 remain in the application. Claim 1 has been amended. A marked-up version of the claim is attached hereto on a separate page.

On pages 2 to 6 of the above-identified Office action, claims 1 and 3 to 6 have been rejected as being fully anticipated by applicants' admitted prior art under 35 U.S.C. § 102, and claims 2 and 7 have been rejected as being obvious over applicants' admitted prior art and further in combination with Leukel (FR 2535898) under 35 U.S.C. § 103.

The rejection has been noted and the claims have been amended in an effort to even more clearly define the invention of the instant application. Support for the changes is found on page 7, lines 2 to 4, for example, of the specification of the instant application.

Before discussing the prior art in detail, it is believed that a brief review of the invention as claimed, would be helpful. Claim 1 calls for, *inter alia*, power semiconductor module, including:

semiconductor components;

a plastic housing having an interior and connecting element openings formed therein;

a substrate disposed in the plastic housing defining a housing base of the plastic housing, the substrate containing a ceramic plate having a top side and a bottom side with a top metallization layer disposed on the top side and a bottom metallization layer disposed on the bottom side, the top metallization layer facing the interior of the plastic housing being patterned in order to form interconnects and equipped for and receiving the semiconductor components;

terminal elements for providing external terminals, the terminal elements press-fitted into the connecting element openings in the plastic housing; and

wires bonded to the terminal elements and to the semiconductor components.

The press-fitting of the invention of the instant application is configured to create a reliable bonding connection in the interior of the housing without encapsulation of the terminal elements by injection molding. This feature is novel and is neither disclosed nor suggested by the prior art. Such a

conclusion is supported in the Declaration filed July 2, 2001 accompanying the Section 116 after final Response. Accordingly, applicants specifically request entry and consideration of this Declaration.

Claim 1 does not solely deal with the simple press fitting of the terminal elements, but rather with the combination of the press-fitting with the reliable bonding capability of the terminal elements in the interior. What is new with respect to the invention of the instant application is that the terminal elements do not have to be encapsulated by injection molding of plastic. Rather, they are fixed suitably by the press fitting.

Hitherto, metal parts, for example, copper parts, were injection-molded into a plastic frame. As such, separate injection-molding tools were necessary, in which, prior to each injection-molding process, the metal parts were inserted and subsequently encapsulated by the injection molding. The prior art fastened aluminum wires on the injection-molded metal parts in a subsequent fabrication step by ultra-sound soldering techniques (bonds), for example, where the wires served as the electrical connection in the interior of the module.

The man-made injection molding material of the prior art, however, had, and continues to have, the disadvantageous characteristic of shrinking when cooling off after the injection molding. This shrinkage leads to loosening of the metal strips (i.e., they are not completely anchored) in the plastic, i.e., the plastic melts away from the metal parts.

The invention of the instant application, however, eliminates the encapsulation of such metal parts by plastic injection molding. Thus, the plastic injection-molding process for creating the frame is simplified. In the invention of the instant application, the metal parts are separately produced and are press-fitted immediately prior to bonding in corresponding grooves in the plastic frame. The grooves in the plastic frame and the corresponding metal parts are shaped such that the metal parts are guided in the groove in a narrow manner and are secured against pulling out by corresponding barbs. Accordingly, the anchoring of the metal parts in the plastic frame is substantially improved to make the bonding as reliable as possible.

Clearly, applicants' admitted prior art does not show the press-fit feature as recited in claim 1 of the instant application.

It is accordingly believed to be clear that none of the references, whether taken alone or in any combination, either show or suggest the features of claim 1. Claim 1 is, therefore, believed to be patentable over the art. The dependent claims are believed to be patentable as well because they all are ultimately dependent on claim 1.

Insofar as claims 2 and 7 are ultimately dependent upon claim 1, and due to the fact that claim 1 is believed to be allowable, these dependent claims are believed to be allowable as well. Thus, the rejection of claims 2 and 7 on pages 4 to 6 of the final Office action under Section 103 is now moot.

In many power semiconductor modules, wires are bonded onto the terminal elements in the interior of the housing, the other end of which is bonded onto semiconductor components. As the plastic shrinks after injection molding, the bond present in the interior of the housing may become detached because the poor mechanical fixing of the terminal elements in the plastic housing allows the terminal elements to move. Thus, the bonded wire may tear or detach itself from the external terminal elements. The invention of the instant application overcomes this disadvantage as set forth above. Leukel is cited in the Section 103 combination rejection. The problems related to wire bonding are entirely foreign and unrelated to the Leukel device because Leukel does not disclose or suggest

wire bonding for connecting terminal elements and semiconductor components. Accordingly, Leukel is not relevant to the features of claim 1 of the instant application.

In view of the foregoing, reconsideration and allowance of claims 1 to 7 are solicited.

In the event the Examiner should still find any of the claims to be unpatentable, counsel would appreciate receiving a telephone call so that, if possible, patentable language can be worked out.

Please charge any fees that might be due with respect to Sections 1.16 and 1.17 to the Deposit Account of Lerner and Greenberg, P.A., No. 12-1099.

Respectfully submitted,

  
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March 4, 2002

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